Claims

1. A method of determining cell cycle phase data for cells comprising at least one luminescent reporter capable of emitting radiation, the at least one luminescent reporter comprising a first luminescent reporter which is capable of being indicative of at least one cell cycle phase, said method comprising:

storing classification information for classifying individual cells into different cell cycle phases using an automated classification process;

receiving image data created by detecting radiation emitted by said at least one luminescent reporter;

analyzing said image data to identify object areas in the image data which correspond to individual cells;

analyzing said image data, on the basis of said identified object areas, to determine, for a selected cell, one or more measurements including a measurement of a parameter relating to at least a cytoplasmic component of the cell; and

applying said classification information to said measurements to classify the selected cell into a selected one of a plurality of sub-populations of cells, each sub-population having cells in a different cell cycle phase.

2. A method according to claim 1, comprising analyzing said image data and applying said classification information to each of a plurality of selected cells, and generating, for said plurality of selected cells, cell cycle phase population data indicative of the relative sizes of said plurality of sub-populations in the selected cells.

3. A method according to claim 1 or 2, comprising performing the method with image data from a plurality of wells containing cells, the said plurality of wells containing different test compounds.

4. A method according to any preceding claim, wherein the at least one luminescent reporter further comprises a second luminescent reporter indicative of the location of a sub-cellular component in a cell,

wherein said step of receiving image data comprises:

a) receiving first image data created by detecting radiation emitted by said first luminescent reporter; and

b) receiving second image data created by detecting radiation emitted by said second luminescent reporter,

wherein said step of analyzing said image data to identify object areas comprises analyzing said second image data, and

wherein said step of analyzing said image data to determine one or more measurements comprises analyzing said first image data.

5. A method according to any preceding claim, wherein said object areas include, for a selected cell, a first type of object area and a second type of object area, and wherein said one or more measurements include a first measurement determined using said first type of object area and a second measurement determined using said second type of object area.

6. A method according to claim 5, wherein said first type of object area is identified using a process arranged to select a predominantly nuclear area of a cell.

7. A method according to claim 5 or 6, wherein said second type of object area is identified using a process arranged to select a predominantly cytoplasmic area of a cell.

8. A method according to claim 5, 6 or 7, wherein said classification information comprises a first classification rule which classifies a selected cell into a selected first one of the plurality of sub-populations of cells, the first classification rule taking into account both said first measurement and said second measurement.

9. A method according to any of claims 5 to 8, wherein said classification information comprises a second classification rule which classifies a selected cell into a selected second one of the plurality of sub-populations of cells, the second classification rule taking into account both said first measurement and said second measurement

10. A method according to any preceding claim, wherein said one or more measurements include a measurement of a cytoplasmic luminescence signal intensity, taken in an area generally corresponding to a cytoplasmic component of a selected cell.

11. A method according to any preceding claim, wherein said one or more measurements include a measurement of a nuclear luminescence signal intensity, taken in an area generally corresponding to a nuclear component of a selected cell.

12. A method according to claim 10 and 11, wherein said classification information includes a rule operative to classify a selected cell, having a relatively low nuclear luminescence signal intensity and a relatively low cytoplasmic luminescence signal intensity, into a first cell cycle phase sub-population.

13. A method according to claim 10 and 11, or claim 12, wherein said classification information includes a rule operative to classify a selected cell, having a relatively low nuclear luminescence signal intensity and a relatively high cytoplasmic luminescence signal intensity, into a second cell cycle phase sub-population.

14. A method according to claim 10 and 11, or claim 12 or 13, wherein said classification information includes a rule operative to classify a selected cell, having a relatively high nuclear luminescence signal intensity and

a relatively low nuclear to cytoplasmic luminescence signal intensity ratio, into a third cell cycle phase sub-population.

15. A method according to claim 10 and 11, or any of claims 12 to 14, wherein said classification information includes a rule operative to classify a selected cell, having a relatively high nuclear luminescence signal intensity and a relatively high nuclear to cytoplasmic luminescence signal intensity ratio, into a fourth cell cycle phase sub-population.

16. A method according to claim 10 and 11, or any of claims 12 to 15, wherein said classification information takes into account a first parameter derived from said measurements which, in combination with a second parameter derived from said measurements, uniquely identifies each one of four different cell cycle phase sub-populations.

17. A method according to any of claims 1 to 3, wherein said step of receiving image data comprises receiving first image data created by detecting radiation emitted by said first luminescent reporter, and

wherein said step of analyzing said image data to determine one or more measurements comprises analyzing said first image data.

18. A method according to claim 17, wherein said step of analyzing said image data to identify object areas comprises analyzing said first image data.

19. A method according to claim 17 or 18, wherein said object areas are identified using a process arranged to select an area including both nuclear and cytoplasmic areas of a cell.

20. A method according to any of claims 17 to 19, wherein said one or more measurements include, for a selected cell, a first measurement

determined using an identified object area and a second measurement determined using an identified object area.

21. A method according to claim 20, wherein said first and second measurements are determined using the same identified object area.

22. A method according to claim 20 or 21, wherein said classification information comprises a classification rule which classifies a selected cell into a selected first one of the plurality of sub-populations of cells, the classification rule taking into account both said first measurement and said second measurement.

23. A method according to any of claims 17 to 22, wherein said one or more measurements include a measurement of a luminescence signal intensity, taken in an identified object area.

24. A method according to any of claims 17 to 23, wherein said one or more measurements include one or more measurements selected from the group consisting of:

a parameter relating to an average signal intensity within an identified object area;

a parameter relating to a fraction of pixels that deviate more than a given amount from an average signal intensity within an identified object area;

a parameter relating to the number of pixels with a signal intensity below a given threshold within an identified object area;

a parameter relating to a ratio between major and minor axes of an elliptical outline corresponding to an identified object area;

a parameter relating to a maximum width of an identified object area;

a parameter relating to an average width of an identified object area;

a parameter relating to signal texture within an identified object area;

a parameter relating to margination in an identified object area.

25. A method according to any preceding claim, wherein said cells comprise a nucleic acid reporter construct, preferably a DNA construct, comprising a nucleic acid sequence encoding a detectable live-cell reporter molecule operably linked to and under the control of:

i) at least one cell cycle phase-specific expression control element, and

ii) a destruction control element.

26. Apparatus arranged to perform the method of any preceding claim.

27. Computer software arranged to perform the method of any preceding claim.

28. A data carrier storing the computer software of claim 27.